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Sierra 942A

RETRANSMISSION UNIT

OPERATION MANUAL

SOM 942A

ISSUE 1

PHILCO Ford

SIERRA ELECTRONIC OPERATION
3885 Bohannon Drive
Menlo Park, California 94025
(415) 322-7222/TWX 910-373-1282

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942A RETRANSMISSION UNIT

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Figure 1-1. Sierra 942A Retransmission Unit

SECTION 1
GENERAL INFORMATION

1.01 This manual describes the Sierra 942A Retransmission Unit (Figure 1-1) and how to use it. Included are specifications, simplified diagrams, and maintenance instructions at the operator level. For calibration or repair, refer to operation/maintenance manual SMM-942A.

1.02 The Sierra 942A is a low-cost instrument designed for line conditioning measurements (relative envelope delay and amplitude) on voice frequency (vf) data transmission circuits. It is used at the remote end of the circuit under test in lieu of the multi-function Sierra 940A Line Conditioning Test Set, or a comparable instrument. At the measurement point, delay and amplitude characteristics are read on the 940A.

1.03 Simplified diagrams of three basic types of testing are shown in Figure 1-2. On the diagrams and throughout this manual, the remote ends of the circuit under test are called transmit point or receive point, respectively, according to whether the swept carrier (with modulation of 25 Hz or 83-1/3 Hz) is transmitted or received.

1.04 When used at the receive point, the 942A retransmits delay and amplitude information about the circuit under test back to the measurement point. The information is sent over the return reference line as modulation on a fixed carrier. Except during initial setup, all adjustments are made on the 940A at the measurement point.

1.05 When used at the transmit point, the 942A receives modulation over the forward reference line on a fixed carrier and retransmits it over the circuit under test. In this direction, the carrier can be tuned manually to a single frequency or swept automatically over the frequency band of interest. There are two optional versions of the 942A, which differ in the way the carrier frequency is controlled.

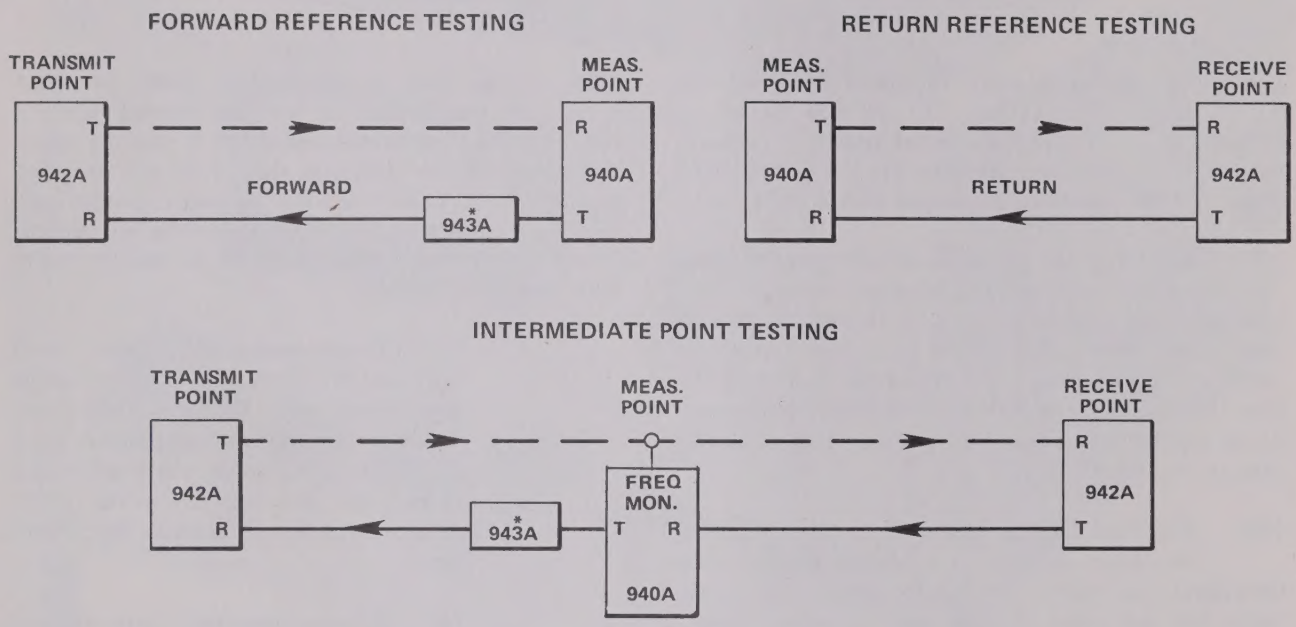
a. **942A-1 Retransmission Unit.** Carrier is tuned by a Sierra 943A Remote Control Unit at the measurement point. The 943A sends a level-controlled signal over the forward reference line to the transmit point, where the 942A-1 converts the level variations on the receive signal to frequency variations on the transmit signal.

b. **942A-2 Retransmission Unit.** Carrier is tuned on the 942A-2, manually or automatically, over a preset sweep time and frequency range.

1.06 Modification kits are available for converting one type of 942A to the other type.

a. **Modification Kit 942A-01.** Converts 942A-2 to 942A-1.

b. **Modification Kit 942A-02.** Converts 942A-1 to 942A-2.



NOTES:

Swept carrier on circuit under test

Fixed carrier on reference line

* 943A at measurement point works with 942A-1 at transmit point. If 943A is not used, transmit point requires 942A-2.

Figure 1-2. Basic Test Circuit Diagrams

SECTION 2
PHYSICAL DESCRIPTION

2.01 The Sierra 942A Retransmission Unit is a lightweight, portable instrument that uses solid-state components, mostly integrated circuits. Input and output circuits are accessible through front panel telephone jacks (for type 310 plugs) or parallel rear panel banana jacks. A front panel meter reads transmit and receive signal levels on 600-ohm or 900-ohm lines. Screwdriver controls for presetting sweep time and range are on the rear panel (942A-2 only). The rear panel also has an ac power input receptacle (a 6-foot power cord is furnished), an ac line fuse, and a switch for selecting 115V or 230V operation. A Bench Model Kit, consisting of a combination handle and tilt-up stand is also included but packaged separately.

ACCESSORIES

2.02 Accessories for the 942A consist of a Rack Mounting Kit (Sierra Part Number A02838501) to allow mounting the unit in a standard 19-inch equipment rack.

OPERATING CONTROLS AND INDICATORS

2.03 Operating controls and indicators are shown in Figure 2-1 and described in Table 2-1. Rear panel controls are shown in Figure 2-2 and described in Table 2-2.

Table 2-1. Front Panel Controls and Indicators

INDEX NO.	NAME/DESCRIPTION	FUNCTION
1	LEVEL meter	Indicates transmit or receive level; also, see (8) and (10).
2	TUNING control	Adjusts RCV END transmit frequency between 0.2 and 4 kHz. An on scale receive signal is required. Also adjusts 942A-2 XMT END frequency with XMT END switch (rear panel) in MAN position.
3	POWER switch	Turns ac power on and off.
4	LOCATION switch	Selects mode of operation of unit; RCV/END allows retransmission of received signal over a fixed carrier frequency. XMT/END allows retransmission of modulation at a fixed level over a manual, swept or remote controlled carrier frequency.
5	TRANSMIT LEVEL control	Adjusts transmit level over range of -20 to +2 dBm; ten-turn potentiometer.
6	TRANSMIT jack	Transmit output; mates with tip-ring-sleeve telephone plug, type 310.
7	IMPEDANCE switch	Selects input and output (receive and transmit) impedances.
8	METER switch	Normally connects metering circuit to indicate receive input level; when pushed in, transfers transmit output signal to metering circuits; momentary pushbutton.
9	RECEIVE jack	Receive input; mates with tip-ring-sleeve telephone plug, type 310.
10	RECEIVE LEVEL vernier	Fine adjusts receive level reading on LEVEL meter; adjustment range is from -20 dB (ccw) to 0 dB (CAL); in CAL position of vernier, meter reads receive level in dBm.
11	RECEIVE LEVEL switch	Selects one of four receive level ranges.

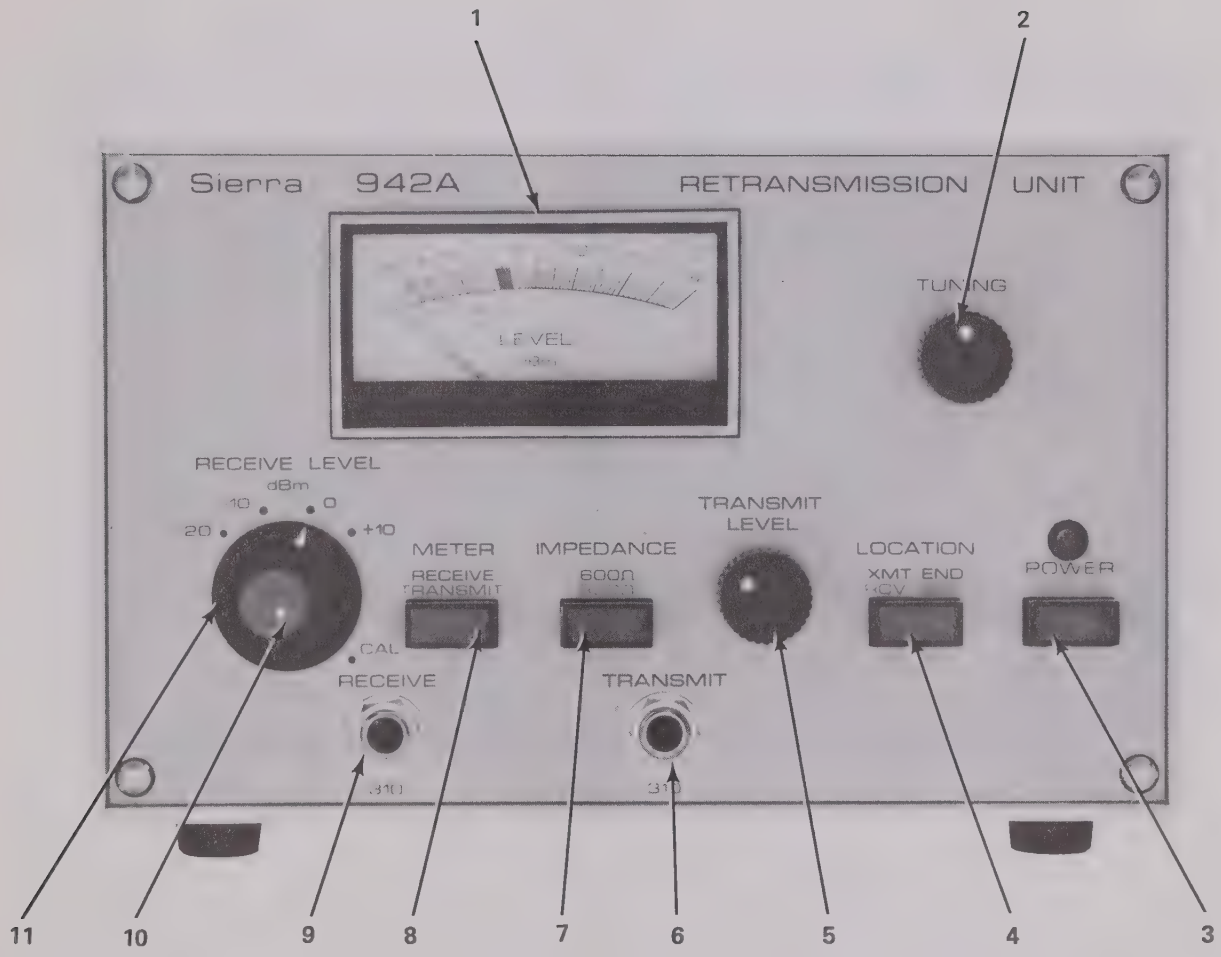


Figure 2-1. Front Panel Controls and Indicators

Table 2-2. Rear Panel Controls and Indicators

INDEX NO.	NAME/DESCRIPTION	FUNCTION
*1	SWEEP HIGH LIMIT control	Sets upper limit of transmit frequency sweep; ten-turn potentiometer with screwdriver adjustment.
*2	SWEEP LOW LIMIT control	Sets lower limit of transmit frequency sweep; ten-turn potentiometer with screwdriver adjustment.
*3	SWEEP TIME control	Sets time of transmit frequency sweep (up or down) between 1 and 30 seconds; ten-turn potentiometer with screwdriver adjustment.
*4	XMT END switch	Selects continuous sweep up or down (AUTO) or manual tuning (MAN) of transmit frequency; two-position slide switch.
5	RECEIVE terminals	Receive input; green (tip) and red (ring) terminals are balanced input and black terminal is chassis ground; paralleled with jack on front panel.
6	TRANSMIT terminals	Transmit or retransmit output; green (tip) and red (ring) terminals are balanced output and black terminal is chassis ground; paralleled with jack on front panel.
7	115/230 switch	Adapts 942A for 115V or 230V ac power input; slide switch.
8	AC Power Fuse	Overload protection for ac power input.
* 942A-2 only		

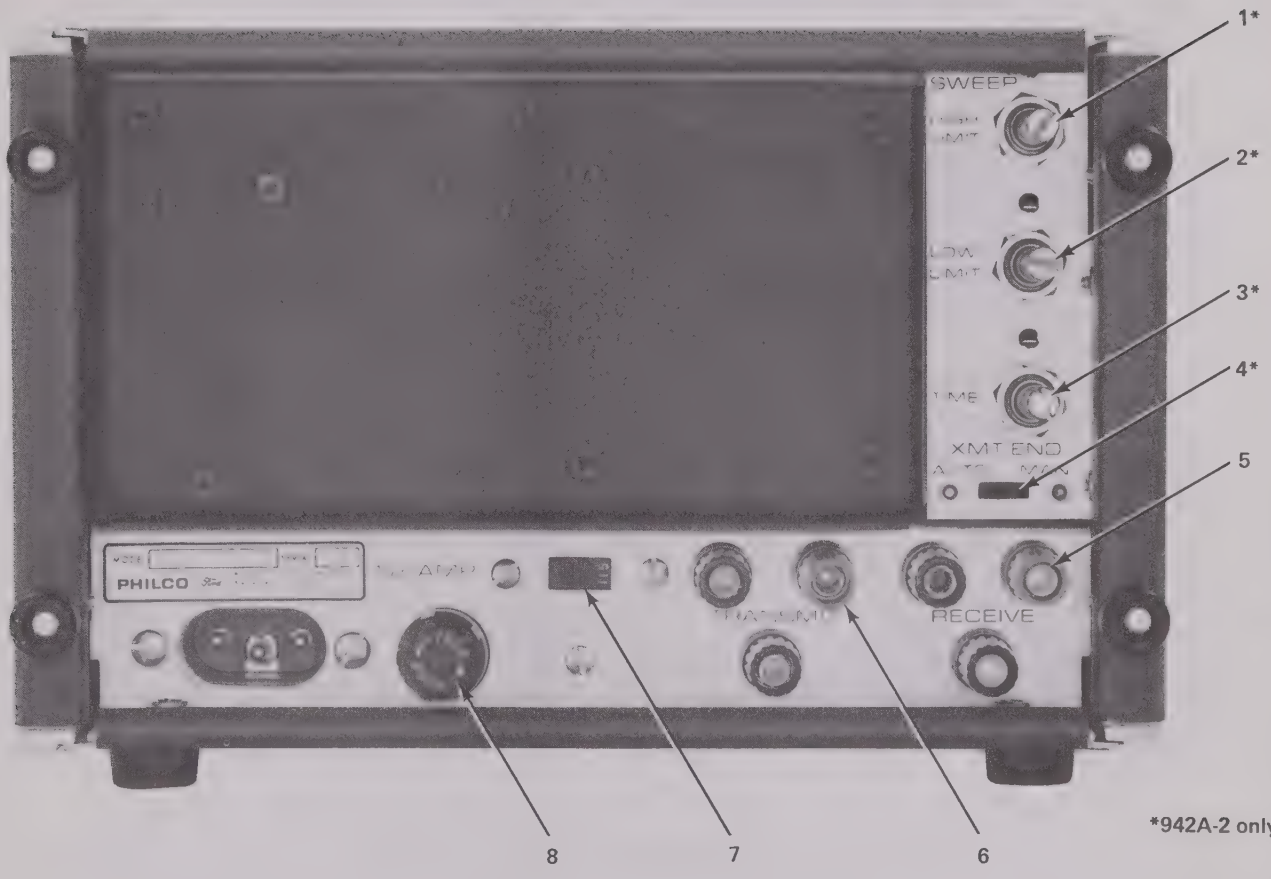


Figure 2-2. Rear Panel Controls and Indicators

SECTION 3
FUNCTIONAL DESCRIPTION

3.01 Figure 3-1 is a block diagram of the 942A Retransmission Unit. By closing the paths through arrowheads designated by circled -1's or -2's, the diagram represents either 942A-1 or 942A-2.

Retransmit Circuit

3.02 On the retransmit path through the 942A, emphasized in Figure 3-1 by a heavy line, incoming signals enter at the front panel RECEIVE jack, which is terminated in 600 ohms or 900 ohms by IMPEDANCE switch S2. An isolation transformer and 10-dB pad are followed by a buffer amplifier, RECEIVE LEVEL controls, and a 30-dB amplifier. RECEIVE LEVEL switch S1 adjusts the step attenuator to accommodate signals in the -40 dBm to +12 dBm range. When the 942A is retransmitting, the vernier is adjusted for a LEVEL meter reading of -6 dB which sets the adjustment range of transmit level to -20 to +2 dBm. The meter reading (-10 to +2 on the meter scale) indicates the level in dBm at the output of the 30-dB amplifier, regardless of the RECEIVE LEVEL switch setting.

3.03 As explained later, level variations in the receive signal from a distant 943A Control Unit are converted by the 942A-1 to frequency variations in the retransmitted signal. To compensate for the varying level, an AGC (automatic gain control) circuit is inserted in the main signal path of the 942A-1 when the LOCATION switch, S3, is in XMT END position. The AGC circuit is able to follow the fastest rate of level change used (sweep rate) to maintain constant level and modulation into the envelope detector for proper demodulation.

3.04 An envelope detector recovers the modulation frequency (25 Hz or 83-1/3 Hz) plus a dc component from the receive signal. The vf carrier is blocked by a 125-Hz lowpass filter, through a buffer amplifier. This varying dc voltage and modulation are applied to a 25-Hz balanced modulator. When S3 is in RCV END, the dc component determines the transmit carrier level. In applications where S3 is in XMT END, the modulator input is deliberately unbalanced by a resistor to ground through S3 so that the modulator has a dc input, with the modulation frequency going through the capacitor. When S3 in in XMT END, the varying dc component is blocked by the capacitor. A steady dc component is provided by the resistor to ground, and the modulation frequency is coupled through the capacitor.

3.05 From the modulator, carrier and sidebands go through a converter that translates the signal down to the 0.2 to 4.0 Hz band. An 11-kHz lowpass filter blocks all but the desired carrier and sidebands resulting from the 25-Hz or 83-1/3 Hz modulation.

3.06 An amplifier with gain adjustable by the TRANSMIT LEVEL control sets the transmit signal at the required level in the -20 to +2 dBm range. After the balancing transformer, output impedance is built out to 600 ohms or 900 ohms by IMPEDANCE switch S2. The transmit signal is available at a front panel jack or at terminals on the rear panel.

Metering Circuit

3.07 The metering circuit consists of a detector (rectifier), dc amplifier, and the LEVEL meter. Through METER switch S1, the circuit is normally connected to the receive branch. Pushing the non-locking switch in to TRANSMIT position disconnects and terminates the outgoing signal and connects the metering circuit across the termination to indicate transmit level.

Transmit Frequency

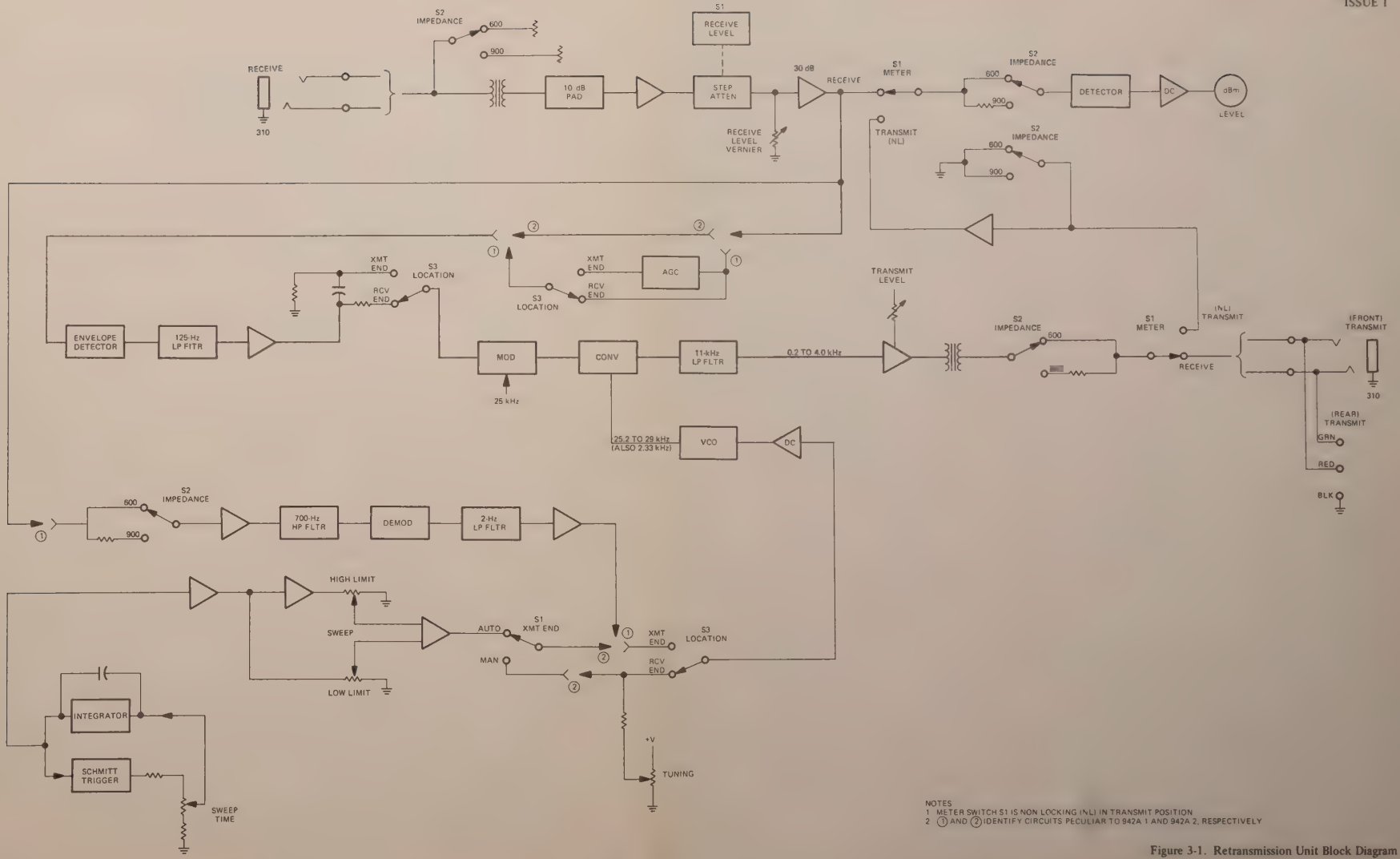
3.08 The frequency of the transmit carrier is established in the converter by a Voltage-Controlled Oscillator (VCO). Control voltage to the VCO comes from one of three sources selected by LOCATION switch S3 and XMT END switch S1.

3.09 942A-1 or -2 With S3 in RCV END. If a signal is being received, with or without modulation, 25-kHz carrier will appear at the converter input. Now, dc voltage from the TUNING control can vary the VCO frequency between 25.2 and 29 kHz and the resultant transmit frequency will be between 0.2 and 4.0 kHz. Without any incoming signal, there will be no 25-kHz input to the converter and no transmit signal.

3.10 942A-1 With S3 in XMT END. On the remote control branch circuit from the main path, the receive signal goes through switch S2, an amplifier, and a 700-Hz highpass filter to the demodulator. The rectified signal from the demodulator continues through a 2-Hz lowpass filter, S3, and a dc amplifier to the VCO. By this means, the signal level from the distant 943A Control Unit establishes the frequency transmitted by the 942A-1. With a -6 dB reading on the LEVEL meter, the VCO output is 26.7 kHz and the converter output is 1700 Hz. The range of levels between -11 dB and -1 dB (on the meter scale) results in 25.2 to 29 kHz at the VCO output and VF frequencies between 0.2 and 4.0 kHz. If there is no input signal, the control voltage decreases to almost zero. The resultant VCO frequency drops to 23.3 kHz and the VF transmit carrier becomes 1700 Hz.

3.11 942A-2 with S3 in XMT END and S1 in MAN. The VF transmit carrier frequency is adjustable between 0.2 and 4.0 kHz by the TUNING control and does not depend on a receive signal. As explained previously, a deliberate dc unbalance is created at the modulator input to cause a 25-kHz output to the converter.

3.12 942A-2 With S3 in XMT END and S1 in AUTO. Sweep voltage of the VCO is generated as a triangular waveform by the sweep generator which is formed by an integrator and Schmitt trigger connected in a closed loop. The period of the waveform is adjustable between 2 and 60 seconds by the SWEEP TIME control. Peak voltages of the waveform, set independently by the HIGH LIMIT and LOW LIMIT controls, determine the sweep frequency range.



NOTES
1 METER SWITCH S1 IS NON LOCKING (NL) IN TRANSMIT POSITION.
2 ① AND ② IDENTIFY CIRCUITS PECULIAR TO 942A 1 AND 942A 2, RESPECTIVELY

Figure 3-1. Retransmission Unit Block Diagram

SECTION 4
SPECIFICATIONS

4.01 Specifications for the 942A are given in Table 4-1.

Table 4-1. 942A Retransmission Unit Specifications

PARAMETER	CHARACTERISTIC
Carrier Frequency	
Range	0.2 to 4.0 kHz unmodulated or with 25 or 83-1/3 Hz 50-percent amplitude modulation
Response	±0.2 dB with reference to 1 kHz
Level	
Receive Level Range	-40 to +12 dBm in four 10 dB steps
Transmit Level Range	-20 to +2 dBm
Meter Calibration	-20 to +2 dBm
Measurement Accuracy at 1 kHz	±0.5 dB from -10 to +2 dBm; ±0.7 dB from -20 to -10 dBm.
Impedance	600 or 900 ohms, ±3%, terminated, balanced
Transmit Output with No Receive Signal	
Frequency, 942A-1	1700 Hz ±100 Hz
Frequency, 942A-2	Adjustable, 0.2 to 4.0 kHz
Modulation	None
Level	-20 to +2 dBm
Receive Level to Transmit Frequency Conversion by 942A-1	
-6 dB	1700 Hz ±10%

Table 4-1. 942A Retransmission Unit Specifications (Cont)

PARAMETER	CHARACTERISTIC
-10.5 dB ±1 dB	200 Hz
-1.5 dB ±1 dB	4000 Hz
Retransmission Linearity of 942A-1	±0.2 dB, -4 to +2 dBm; ±0.4 dB, -10 to -4 dBm (reference, 0 dBm at 1700 Hz)
Sweep Time Up or Down, 942A-2	Adjustable, 1 to 30 seconds
Common Mode Rejection Ratio	50 dB minimum
Input Protection	500 Vdc, each balanced terminal to ground; 150 volts peak for 50 ms between balanced terminals
Temperature Range	
Operating	32° to 122°F (0° to 50°C)
Storage	-4° to 117°F (-20° to 65°C)
Power	115 or 230 Vac ±10%, 48 to 420 Hz, 25 VA
Size	
Height	5-1/4 inches (13.3 mm)
Width	8-3/8 inches (21.3 mm)
Depth	12 inches (30.5 mm)
Weight	15 pounds (6.8 kg)

SECTION 5
OPERATION

RECEIVING INFORMATION

5.01 When the 942A is received, unpack it and inspect it carefully for damage. Keep the shipping carton. Check the equipment received against the order. A standard three-wire power cord is furnished; test cords can be ordered separately.

5.02 To ensure that the 942A is in good working condition, it should be checked out by performing the procedure of paragraph 5.04. If the unit is damaged or does not operate properly, contact the Customer Service Department for instructions.

ADDRESS: Customer Service Department
Sierra Electronic Operation
38 Philco -Ford Corporation
3885 Bohannon Drive
Menlo Park, California 94025
(415) 322-7222
TWX 910-373-1282

NOTE: Do not repackage damaged or faulty equipment for reshipment to Sierra Electronic Operation under the provisions of the Warranty without first contacting Sierra for specific instructions.

Power Turn-On

5.03 In the following procedures the 942A is operated in conjunction with a Sierra 940A Line Conditioning Test Set, or equivalent. For all applications, the test equipment must be connected to a 115-volt or 230-volt ac power source of 48 to 420 Hz.

CAUTION: For 230-volt operation, the 115/230 switch on the rear panel must be in the 230 position. Otherwise, the test equipment will be damaged when power is turned on.

Step 1
Connect ac line receptacle on rear panel to ac power source.

Step 2
On 940A test set only, turn DELAY RANGE switch to OFF and METER switch to TRANSMIT LEVEL.

Step 3
Set POWER switch to ON and allow equipment to warm up for about 15 minutes.

OPERATIONAL TEST

5.04 In the procedure that follows, the performance of the 942A is checked out using a 940A test set as a VF signal source, level meter, and frequency counter. Testing covers: accuracy of level measurement, transmit signal range (level and frequency), remote control of 942A-1 transmit signal frequency, and automatic tuning of 942A-2 transmit signal.

Step 1
Turn on 940A and 942A as described in paragraph 5.03.

Step 2
Set controls on 940A as follows:

FUNCTION switch to MEASURE
MODULATION switch to OFF
IMPEDANCE switch to 600

TUNING MODE switch to 100 Hz LOCK or MANUAL
DELAY RANGE switch to OFF

METER switch to TRANSMIT LEVEL
FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL

TRANSMIT LEVEL switch to 0 dBm
RECEIVE LEVEL switch to 0 dBm
RECEIVE LEVEL vernier to CAL

Step 3
Set controls on 942A as follows:

IMPEDANCE switch to 600 Ω
LOCATION switch to RCV END
RECEIVE LEVEL switch to 0 dBm
RECEIVE LEVEL vernier to CAL

Step 4
Connect TRANSMIT and RECEIVE on 940A to RECEIVE and TRANSMIT, respectively, on 942A.

Step 5
Adjust MANUAL TUNING control on 940A for FREQUENCY display of 1.70 kHz.

Step 6
On 940A, adjust TRANSMIT LEVEL vernier for LEVEL meter reading of -6.0 dBm. On 942A, LEVEL meter should read -6.0 dBm ±0.1 dB.

Step 7
Turn METER switch on 940A to RECEIVE LEVEL.

Step 8
Adjust TRANSMIT LEVEL control on 942A through its range and read levels on 940A. Requirement: greater than +3.8 dBm (cw) to less than -20.0 dBm (ccw).

Step 9
Adjust TRANSMIT LEVEL control on 942A for 0.0 dBm on LEVEL meter of 940A.

Step 10
On 942A, push in METER switch. LEVEL meter on 942A should read 0.0 dBm ± 0.1 dB.

Step 11
Adjust TUNING control on 942A and check range on FREQUENCY display of 940A. Requirement: less than 0.20 kHz to greater than 4.00 kHz.

Step 12
On the 942A, set LOCATION switch to XMT END.

Step 13
This step is not applicable to 942A-2. On 940A, adjust TRANSMIT LEVEL controls for readings on 942A-1 LEVEL meter of -1, -6, and -11 dBm. At each level, read FREQUENCY display on 940A. Requirement: greater than 4.00 kHz at -1 dBm; 1.70 kHz +0.10 kHz at -6 dBm; and less than 0.20 kHz at -11 dBm.

NOTE: The remaining steps in this procedure are not applicable to the 942A-1.

Step 14
Set controls on rear panel of 942A-2 as follows:

XMT END switch to AUTO
SWEEP HIGH LIMIT control full cw
SWEEP LOW LIMIT control full ccw
SWEEP TIME control full cw

Step 15
Read sweep range on FREQUENCY display of 940A. Requirement: less than 0.20 kHz to greater than 4.00 kHz.

Step 16
Check total sweep time (up and down) by timing interval between two successive readings of highest transmit frequency. Requirement: 60 seconds or more.

Step 17
Turn SWEEP TIME control full ccw and repeat step 16. Requirement: 2 seconds or less.

Step 18
Set XMT END switch to MAN.

Step 19
Adjust TUNING control on 942A and check range on FREQUENCY display of 940A. Requirement: less than 0.20 kHz to greater than 4.00 kHz.

Level Readings

5.05 In the operating procedures, references are made to LEVEL meter readings. Unless otherwise specified, this means the algebraic sum of the setting of the TRANSMIT LEVEL switch (940A test set only) or RECEIVE LEVEL switch, as selected by the METER switch, and the reading on the meter scale. For example, a switch setting of -10 and a meter scale reading of +2 would be a level of -8 dB. (See next paragraph for dBm.)

5.06 If the circuit connected to the test equipment has a characteristic impedance that agrees with the setting of the IMPEDANCE switch, then transmit levels on the circuit, as read on the 940A or 942A, will be in dBm. For receive levels to be in dBm, the RECEIVE LEVEL vernier must be in the CAL position.

Presetting Sweep Controls on 942A-2

5.07 In the following procedure, the sweep frequency limits and sweep time of the 942A-2 unit are preset to the required values using the rear panel screwdriver controls. The output of the 942A-2 is sent over a VF circuit to another location where frequency is measured on a 940A test set. Instead, frequency could be measured locally on a 940A test set or an electronic counter. If the sweep characteristics of the 942A-2 are being adjusted as part of the test procedures in Table 5-1 or Table 5-6, begin at step 4.

Step 1
Turn on test equipment as described in paragraph 5.03.

Step 2
Set controls on 940A as follows:

FUNCTION switch to MEASURE
IMPEDANCE switch as applicable
METER switch to RECEIVE LEVEL
FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL

Step 3
Set controls on 942A-2 as follows:

LOCATION switch to XMT END
XMT END switch (rear panel) to MAN
IMPEDANCE switch as applicable

Step 4
Connect TRANSMIT on 942A-2 to RECEIVE on 940A, directly or through the VF circuit between locations.

Step 5
On the 941A-2, push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit test tone level of VF circuit.

Step 6
Adjust TUNING control on 942A-2 for FREQUENCY display on 940A of test tone frequency for VF circuit.

Step 7
On 940A, adjust RECEIVE LEVEL switch and vernier for an on-scale meter reading.

Step 8
Set XMT END switch on 942A-2 to AUTO.

Step 9
If necessary, turn SWEEP TIME control on 942A-2 clockwise to slow sweeping enough for frequency limits to be noted.

Step 10
Adjust HIGH LIMIT and LOW LIMIT controls to establish the required sweep frequency range.

Step 11
Adjust SWEEP TIME control as required. Total sweep time can be determined most easily by timing the interval between successive readings of the highest or lowest frequency.

Circuit Loss Measurement

5.08 In the procedures of Table 5-1, circuit loss is measured between a local point equipped with a 940A Line Conditioning Test Set and a remote point equipped with a 942A Retransmission Unit. Loss is measured in both directions of the four-wire circuit, forward and return. At the remote point, the transmit carrier is tuned on the 942A while its frequency is monitored on the 940A at the local point.

5.09 At the remote point, either a 942A-1 or -2 may be used to measure the receive signal level and to generate the transmit signal. The transmit signal frequency of both units can be manually tuned over the VF band. However, one difference in the two types of units is that the 942A-1 must be receiving a signal; otherwise, its transmit output is fixed at 1700 Hz.

Line Conditioning Measurements

5.10 Line conditioning means equalization of a data transmission circuit to compensate for variations in relative delay and relative amplitude over the VF frequency range. Line conditioning measurements are covered in Tables 5-2 and 5-6 with associated test setups in Figures 5-1 through 5-6. These procedures use three basic types of testing: return reference, forward reference, and intermediate point. In each type, the circuit under test must have a parallel line in the other direction of transmission.

5.11 **Return Reference Testing.** In return reference testing, in a 940A Line Conditioning Test Set at the local measurement point, a swept carrier is modulated with 25 Hz or 83-1/3 Hz and sent over the circuit under test. In a 942A Retransmission Unit at the remote receive

point, the modulation is recovered by an envelope detector and applied to a fixed carrier that is transmitted to the local point via the return reference line. Because the carrier frequency is fixed, varying delay and amplitude information acquired on the forward transmission, and contained in the modulation, is altered uniformly on the return trip; the relative values over the frequency range do not change. Delay and amplitude characteristics of the circuit under test are read on the 940A.

5.12 **Forward Reference Testing.** From a 940A at the local measurement point, a modulated fixed carrier is transmitted over the forward reference line to a 942A at the remote point. There, the modulation is recovered and applied to a swept carrier that is transmitted to the local point over the circuit under test. Again, delay and amplitude characteristics are read on the 940A.

5.13 The 942A-1 and -2 units use different techniques for sweeping the transmit carrier frequency. With the 942A-1 at the transmit point, a 943A Control Unit at the measurement point sweeps the level of the outgoing carrier; the 942A-1 converts these receive level variations to transmit frequency variations on the circuit under test. In contrast, the 942A-2 at the transmit point has its own sweep generator with rear panel screwdriver controls for presetting the sweep rate and frequency limits. Continuous up and down sweeping is initiated when the rear panel XMT END switch is operated to AUTO.

5.14 **Intermediate Point Testing.** When an adjustable equalizer is at an intermediate location in a transmission line, intermediate point testing enables the effect of an equalizer adjustment to be immediately apparent to the craftsman. This type of testing is a combination of the two types just described: forward reference and return reference. From the measurement point, modulation travels on a fixed carrier over a forward reference line to the transmit point. There, the modulation is retransmitted on a swept carrier over the circuit under test to the receive point. Modulation containing delay and amplitude information is returned on a fixed carrier to the measurement point where circuit characteristics are read on the 940A.

5.15 **Delay Reference Set.** As a preliminary step in delay measurement, the DELAY REF SET button on the 940A test set is pushed while the test set is receiving the zero-delay reference frequency. This synchronizes the local timing pulse with the phase of incoming modulation and causes the DELAY meter to read zero. If the reference line or circuit under test is interrupted during frequency sweeping, the delay reference must be reset on the 940A as in the preliminary step described above.

Table 5-1. Circuit Loss Measurement

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment. (Figure 5-1) as described in paragraph 5.03.	
2	Connect test equipment as shown in Figure 5-1.	
	MEASUREMENT POINT	**TRANSMIT/RECEIVE POINT**
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to OFF IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to OFF FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL RECEIVE LEVEL vernier to CAL METER switch to TRANSMIT LEVEL	

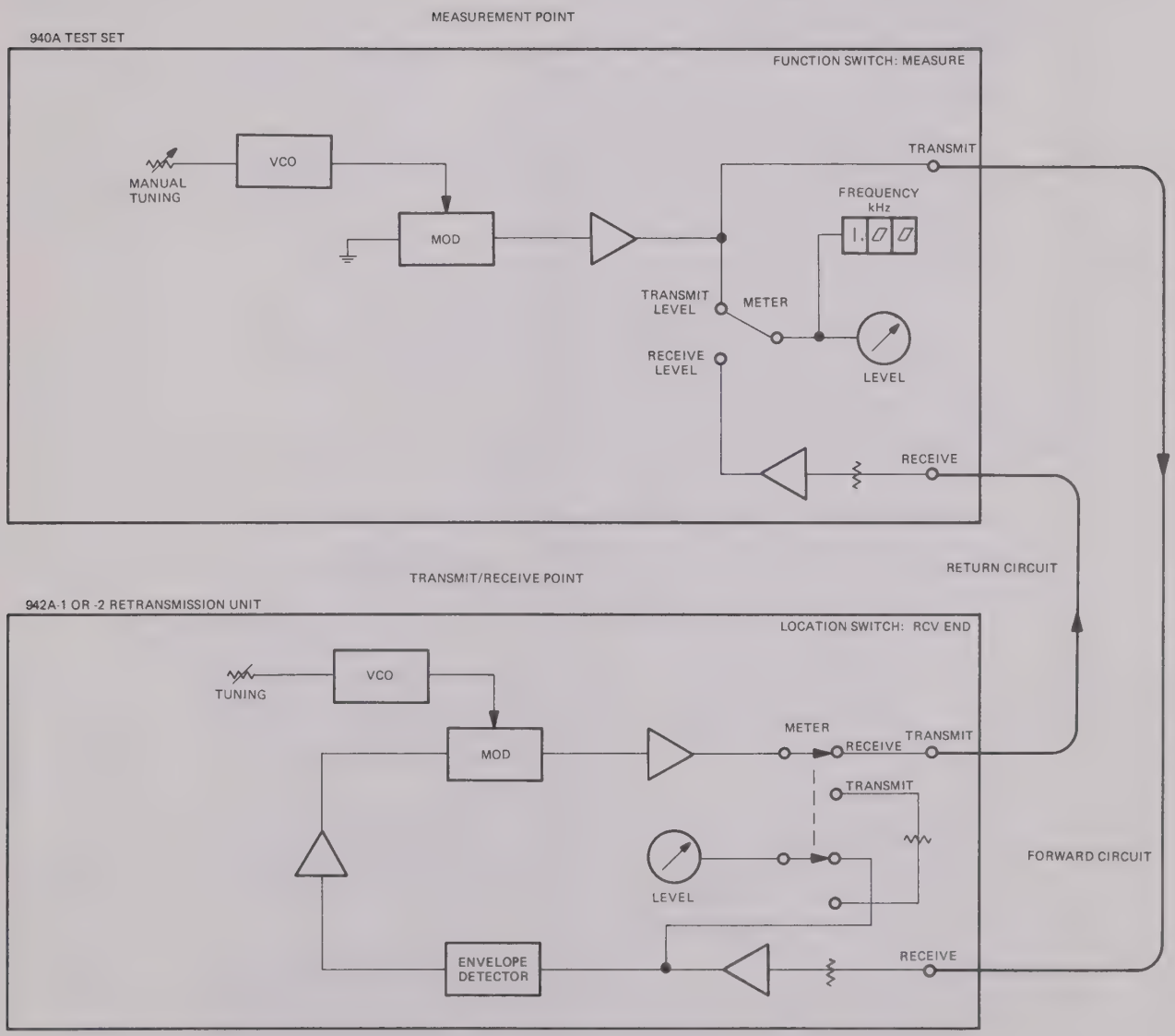


Figure 5-1. Circuit Loss Measurement

Table 5-1. Circuit Loss Measurement (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT/RECEIVE POINT
4	Adjust MANUAL TUNING control for FREQUENCY display of test tone frequency, for example 1000 Hz. NOTE: If the forward circuit impedance is a poor match to the output impedance of the test set, in setting the transmit level in the next step, temporarily disconnect the forward circuit and connect a 600- or 900-ohm (as applicable) resistor termination to the TRANSMIT terminals, or loop TRANSMIT terminals to RECEIVE.	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit for forward circuit.	
6	Turn METER switch to RECEIVE LEVEL.	
7		Set controls on 942A as follows: LOCATION switch to RCV END IMPEDANCE switch as applicable RECEIVE LEVEL vernier to CAL
8		Adjust RECEIVE LEVEL switch for an on-scale LEVEL meter reading.
9		To determine forward circuit loss, algebraically subtract transmit level in step 5 from receive level in step 7. (A minus remainder is a loss, a plus is a gain.)
10		Adjust RECEIVE LEVEL vernier for -6 dB on LEVEL meter scale.
11		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return circuit.
12		Adjust TUNING control on 942A for FREQUENCY display on 940A at measurement point of test tone frequency.

Table 5-1. Circuit Loss Measurement (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT/RECEIVE POINT
13	Adjust RECEIVE LEVEL switch for an on-scale LEVEL meter reading.	
14	To determine return circuit loss, algebraically subtract transmit level in step 11 from receive level in step 13.	

Table 5-2. Return Reference Testing With 942A-1 or -2 at Receive Point

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 5-2) as described in paragraph 5.03.	
2	Connect test equipment as shown in Figure 5-2.	
	MEASUREMENT POINT	RECEIVE POINT
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL SWEEP TIME STEP switch to 1/4 sec SWEEP TIME FINE control to CAL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
4	Adjust MANUAL TUNING control for FREQUENCY display of zero-level reference frequency for circuit under test, for example 1000 Hz.	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for circuit under test.	

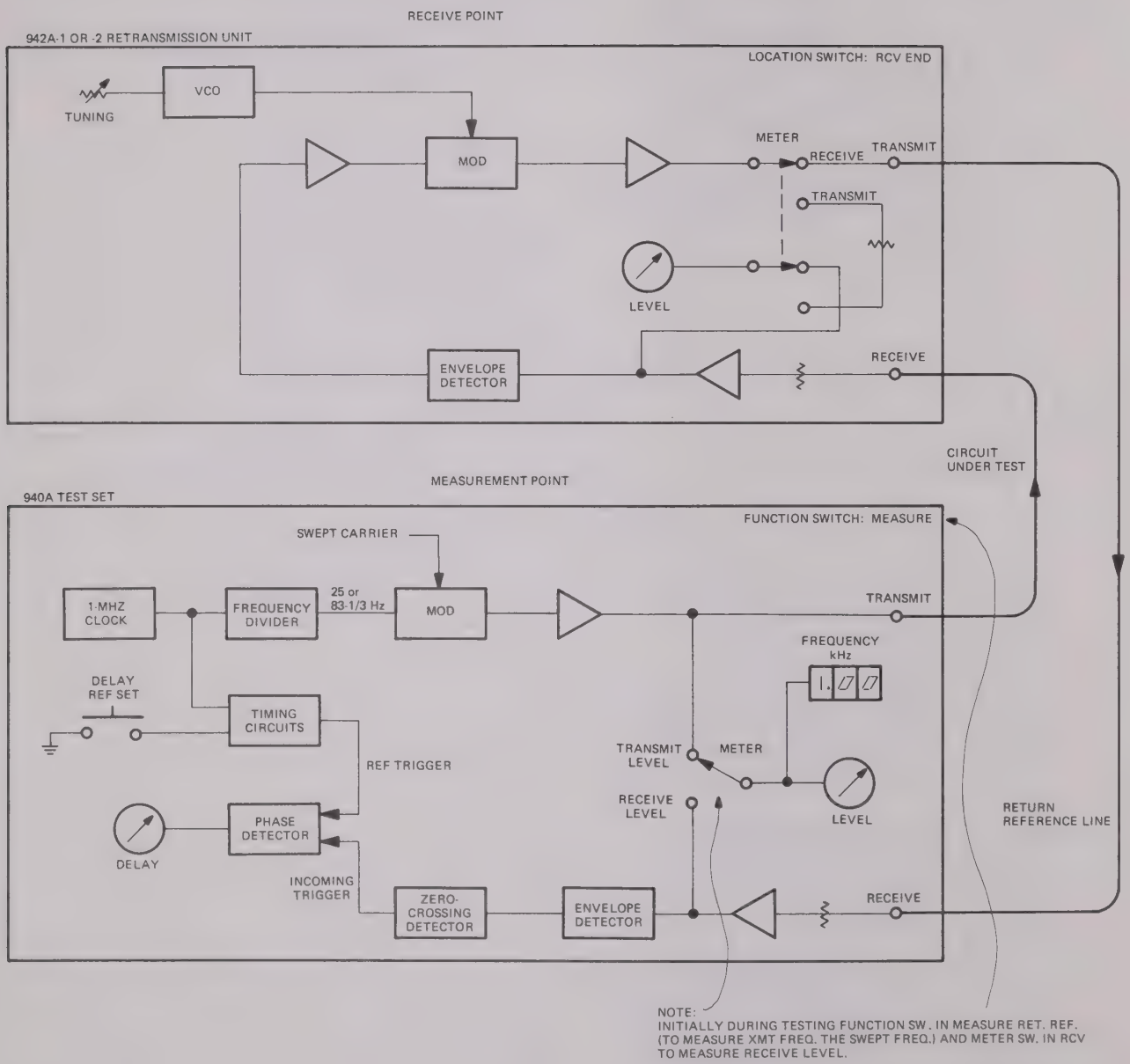


Figure 5-2. Return Reference Testing With 942A-1 or -2 at Receive Point

Table 5-2. Return Reference Testing With 942A-1 or -2 at Receive Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
6	Turn METER switch to RECEIVE LEVEL.	
7		Set controls on 942A as follows: LOCATION switch to RCV END IMPEDANCE switch as applicable
8		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
9		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return reference line.
10		Adjust TUNING control on 942A for FREQUENCY display on 940A at measurement point of test tone frequency for return reference line (typically 1.80 kHz).
11	Adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
12	Set FUNCTION switch to MEAS RET REF and adjust MANUAL TUNING control for FREQUENCY display of zero-delay reference frequency for circuit under test (typically 1.7 kHz or 1.8 kHz).	
13	Push DELAY REF SET button. DELAY meter should read 0 μs.	
14	Turn DELAY RANGE switch to 90. DELAY meter should read 0 $\pm$2 μs.	
15	Turn TUNING MODE switch to SINGLE SWEEP and METER switch to TRANSMIT LEVEL.	
16	Adjust SWEEP LIMITS LOW control for FREQUENCY display of lowest frequency in band of interest. (If adjustment doesn't affect frequency, push START button and then adjust the control.)	
17	Push START button.	

Table 5-2. Return Reference Testing With 942A-1 or -2 at Receive Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
18	Adjust SWEEP LIMITS HIGH control for FREQUENCY display of highest frequency in band of interest.	
19	Turn TUNING MODE switch to SWEEP.	
20	Set SWEEP TIME STEP switch and FINE control for desired sweep time.	
21	Adjust DELAY RANGE switch for optimum DELAY meter readings over the swept band.	
22	Record level and delay information as required.	

Table 5-3. Forward Reference Testing With 942A-1 at Transmit Point

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 5-3) as described in paragraph 5.03.	
	MEASUREMENT POINT	TRANSMIT POINT
2	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
3	Connect TRANSMIT and RECEIVE on 940A to RECEIVE and TRANSMIT, respectively on 943A.	

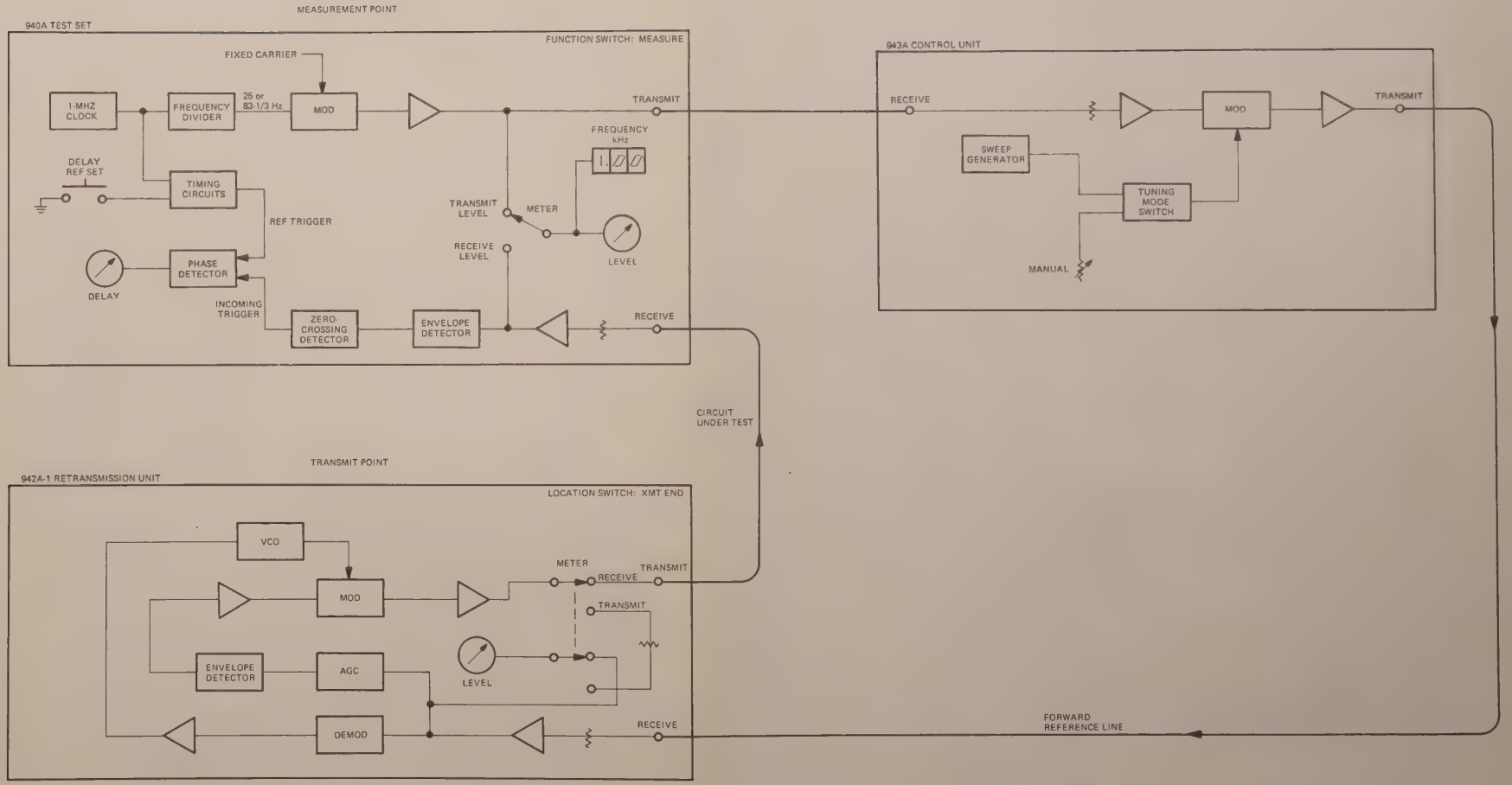


Figure 5-3. Forward Reference Testing With 942A-1 at Transmit Point

Table 5-3. Forward Reference Testing With 942A-1 at Transmit Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
4	Set controls on 943A as follows: IMPEDANCE switch as applicable (same as 940A) TUNING MODE switch to REFERENCE	
5	Adjust MANUAL TUNING control on 940A for FREQUENCY display of 1.70 kHz.	
6	Adjust TRANSMIT LEVEL switch and vernier on 940A for LEVEL meter reading of -6 dBm.	
7	Turn METER switch on 940A to RECEIVE LEVEL.	
8	Adjust TRANSMIT LEVEL control on 943A for LEVEL meter reading on 940A of transmit level for forward reference line.	
9	Connect 940A and 943A as shown in Figure 5-3.	
10		Connect 942A-1 as shown in Figure 5-3.
11		Set controls on 942A-1 as follows: LOCATION switch to XMT END IMPEDANCE switch as applicable
12		Adjust RECEIVE LEVEL switch and vernier for RCV REF, -6 dB on LEVEL meter scale. (At this level, the transmit frequency will be 1700 ±10 Hz.)
13		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test. NOTE: No further adjustment of controls on the 942A-1 should be necessary.
14	Turn TUNING MODE switch on 943A to MANUAL.	

Table 5-3. Forward Reference Testing With 942A-1 at Transmit Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
16	On 940A, adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
17	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-delay reference frequency for circuit under test. (If 1700 Hz is satisfactory for reference, then turn TUNING MODE switch to REFERENCE. If desired, the 942A transmit frequency can be trimmed by adjusting the 943A TRANSMIT LEVEL control.)	
18	Push DELAY REF SET button on 940A. DELAY meter should read 0 μs.	
19	Turn DELAY RANGE switch on 940A to 90. DELAY meter should read 0 $\pm$2 μs.	
20	On 943A, turn TUNING MODE switch to SINGLE SWEEP.	
21	On 943A, adjust SWEEP LIMITS LOW control for FREQUENCY display on 940A of lowest frequency in band of interest. (If adjustment doesn't affect frequency, push START button and then adjust control.)	
22	Push START button on 943A.	
23	Adjust SWEEP LIMITS HIGH control on 943A for FREQUENCY display on 940A of highest frequency in band of interest.	
24	Turn TUNING MODE switch on 943A to SWEEP.	
25	Set SWEEP TIME switch and FINE control on 943A for desired sweep time.	
26	Adjust DELAY RANGE switch on 940A for optimum DELAY meter readings over the swept band.	
27	Record level and delay information as required.	

Table 5-4. Forward Reference Testing With 942A-2 at Transmit Point

STEP	PROCEDURE	
1	At each end of circuit under test, turn on test equipment (Figure 5-4) as described in paragraph 5.03.	
2	Connect test equipment as shown in Figure 5-4.	
	MEASUREMENT POINT	**TRANSMIT POINT**
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
4	Adjust MANUAL TUNING control for FREQUENCY display of test tone frequency for forward reference line (typically, 1.80 kHz).	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for forward reference line.	
6		Set controls on 942A-2 as follows: LOCATION switch to XMT END IMPEDANCE switch as applicable XMT END switch (rear panel) to MAN
7		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
8		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test.
9	Turn METER switch to RECEIVE LEVEL.	
10		Adjust TUNING control on 942A-2 for FREQUENCY display on 940A at measurement point of zero-level reference frequency for circuit under test.

Table 5-4. Forward Reference Testing With 942A-2 at Transmit Point (cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
11	Adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
12		Adjust TUNING control on 942A-2 for FREQUENCY display on 940A at measurement point of zero-delay reference frequency for circuit under test.
13	Push DELAY REF SET button. DELAY meter should read 0 μs.	
14	Turn DELAY RANGE switch to 90. DELAY meter should read 0 $\pm$2 μs.	
15		Operate XMT END switch (rear panel) to AUTO.
16		Adjust SWEEP controls on rear panel for required frequency limits and sweep time. See paragraph 5.07.
17	Adjust DELAY RANGE switch for optimum DELAY meter reading over the swept band.	
18	Record level and delay information as required.	

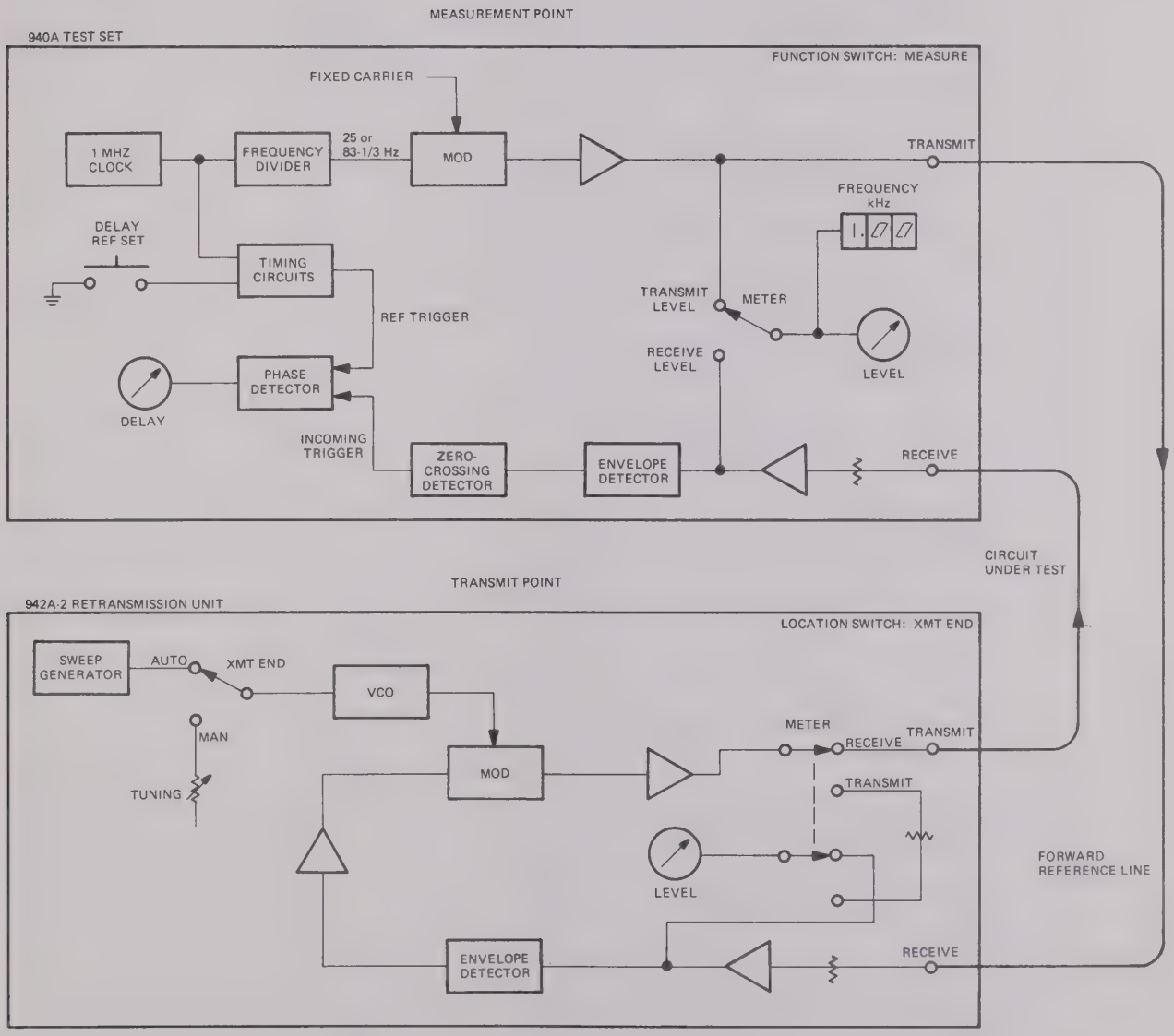


Figure 5-4. Forward Reference Testing With 942A-2 Transmit Point

Table 5-5. Intermediate Point Testing With 942A-1 at Transmit Point

STEP	PROCEDURE	
1	At intermediate point and at each end of circuit under test, turn on test equipment (Figure 5-5) as described in paragraph 5.03.	
	MEASUREMENT POINT	TRANSMIT POINT
2	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
3	Connect TRANSMIT and RECEIVE on 940A to RECEIVE and TRANSMIT, respectively, on 943A.	
4	Set controls on 943A as follows: IMPEDANCE switch as applicable (same as 940A) TUNING MODE switch to REFERENCE	
5	Adjust MANUAL TUNING control on 940A for FREQUENCY display of 1.70 kHz.	
6	Adjust TRANSMIT LEVEL switch and vernier on 940A for LEVEL meter reading of -6 dBm.	
7	Turn METER switch on 940A to RECEIVE LEVEL.	
8	Adjust TRANSMIT LEVEL control on 943A for LEVEL meter reading on 940A of transmit level for forward reference line.	
9	Connect 940A and 943A as shown in Figure 5-5.	

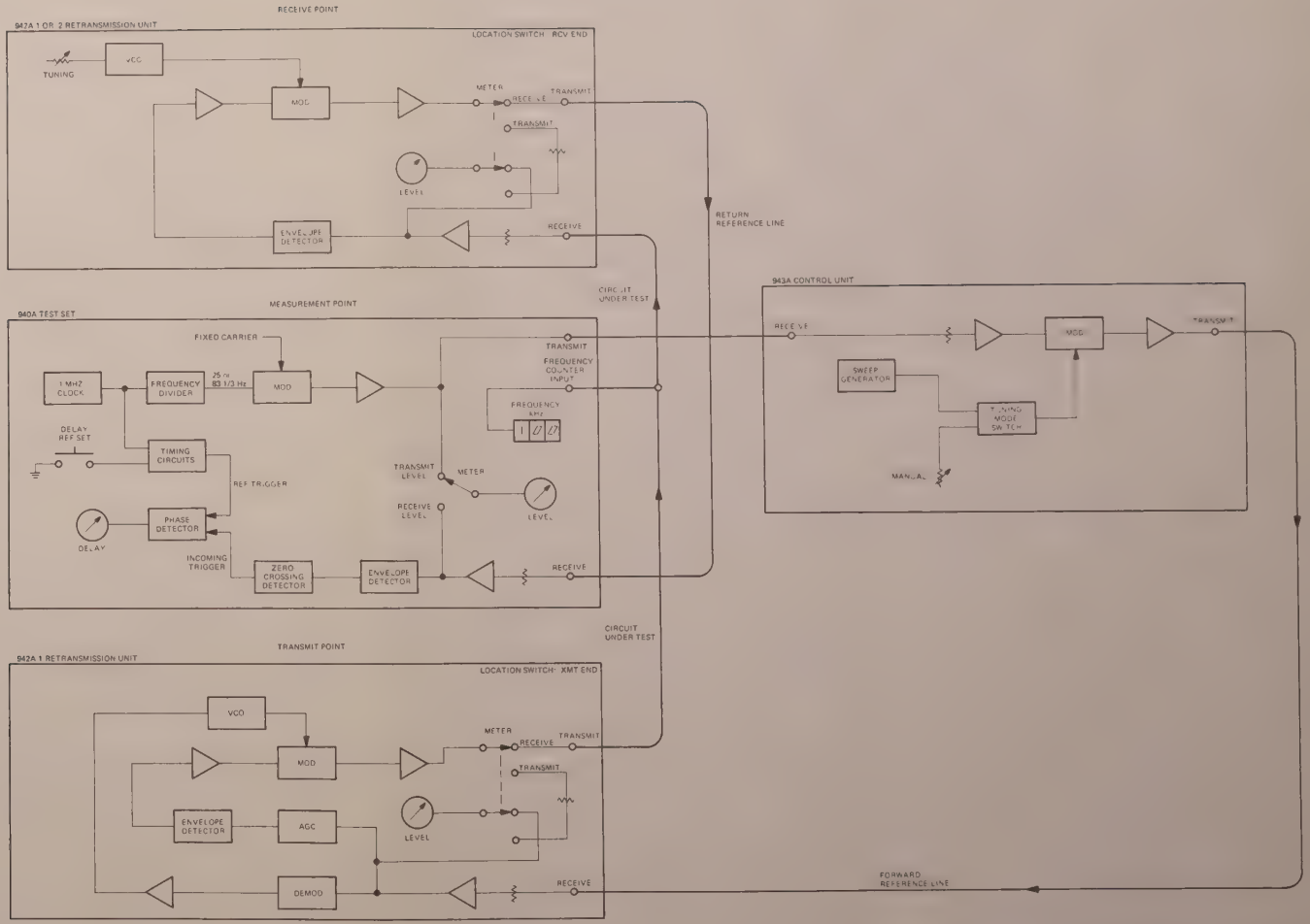


Figure 5-5. Intermediate Point Testing With 942A-1 at Transmit Point

Table 5-5. Intermediate Point Testing With 942A-1 at Transmit Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	TRANSMIT POINT
10		Connect 942A-1 as shown in Figure 5-5.
11		Set controls on 942A-1 as follows: LOCATION switch to XMT END IMPEDANCE switch as applicable
12		Adjust RECEIVE LEVEL switch and vernier for RCV REF, -6 dB on LEVEL meter scale. (at this level, the transmit frequency will be 1700 ± 10 Hz.)
13		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test. NOTE: No further adjustment of controls on the 942A-1 should be necessary.
		RECEIVE POINT
14		Connect 942A-1 or -2 as shown in Figure 5-5.
15		Set controls on 942A as follows: LOCATION switch to RCV END IMPEDANCE switch as applicable
16		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
17		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for return reference line.
18		Adjust TUNING control on 942A for frequency display on 940A at measurement point of test tone frequency for return reference line (typically, 1.80 kHz).
19	Set FREQUENCY COUNTER INPUT switch on 940A (rear panel) to EXTERNAL.	
20	Turn TUNING MODE switch on 943A to MANUAL.	

Table 5-5. Intermediate Point Testing With 942A-1 at Transmit Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
21	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-level reference frequency for circuit under test.	
22	On 940A, adjust RECEIVE LEVEL switch and vernier for convenient reading on LEVEL meter scale (0 dB, for example).	
23	Adjust MANUAL tuning control on 943A for FREQUENCY display on 940A of zero-delay reference frequency.	
24	Push DELAY REF SET button on 940A. DELAY meter should read 0 μs.	
25	Turn DELAY RANGE switch on 940A to 90. DELAY meter should read 0 $\pm$2 μs.	
26	On 943A, turn TUNING MODE switch to SINGLE SWEEP.	
27	On 943A, adjust SWEEP LIMITS LOW control on FREQUENCY display on 940A of lowest frequency in band of interest. (If adjustment doesn't affect frequency, push START button and then adjust control.)	
28	Push START button on 943A.	
29	Adjust SWEEP LIMITS HIGH control for FREQUENCY display on 940A of highest frequency in band of interest.	
30	Turn TUNING MODE switch to SWEEP.	
31	Set SWEEP TIME switch and FINE control for desired sweep time.	
32	Adjust DELAY RANGE switch on 940A for optimum DELAY meter readings over the swept band.	
33	Record level and delay information as required.	

Table 5-6. Intermediate Point Testing With 942A-2 at Transmit Point

STEP	PROCEDURE	
1	At intermediate point and at each end of circuit under test, turn on test equipment (Figure 5-6) as described in paragraph 5.03.	
2	Connect test equipment as shown in Figure 5-6.	
	MEASUREMENT POINT	**TRANSMIT POINT**
3	Set controls on 940A as follows: FUNCTION switch to MEASURE MODULATION switch to 25 Hz or 83-1/3 Hz IMPEDANCE switch as applicable TUNING MODE switch to 100 Hz LOCK or MANUAL DELAY RANGE switch to 9000 METER switch to TRANSMIT LEVEL FREQUENCY COUNTER INPUT switch (rear panel) to INTERNAL	
4	Adjust MANUAL TUNING control for FREQUENCY display of test tone (frequency for forward reference line (typically, 1.80 kHz).	
5	Adjust TRANSMIT LEVEL switch and vernier for LEVEL meter reading of transmit level for forward reference line.	
6	Set FREQUENCY COUNTER INPUT switch (rear panel) to EXTERNAL.	
7		Set controls on 942A-2 as follows: LOCATION switch to XMT END XMT END switch (rear panel) to MAN IMPEDANCE switch as applicable
8		Adjust RECEIVE LEVEL switch and vernier for -6 dB on LEVEL meter scale.
9		Push in METER switch and adjust TRANSMIT LEVEL control for LEVEL meter reading of transmit level for circuit under test.

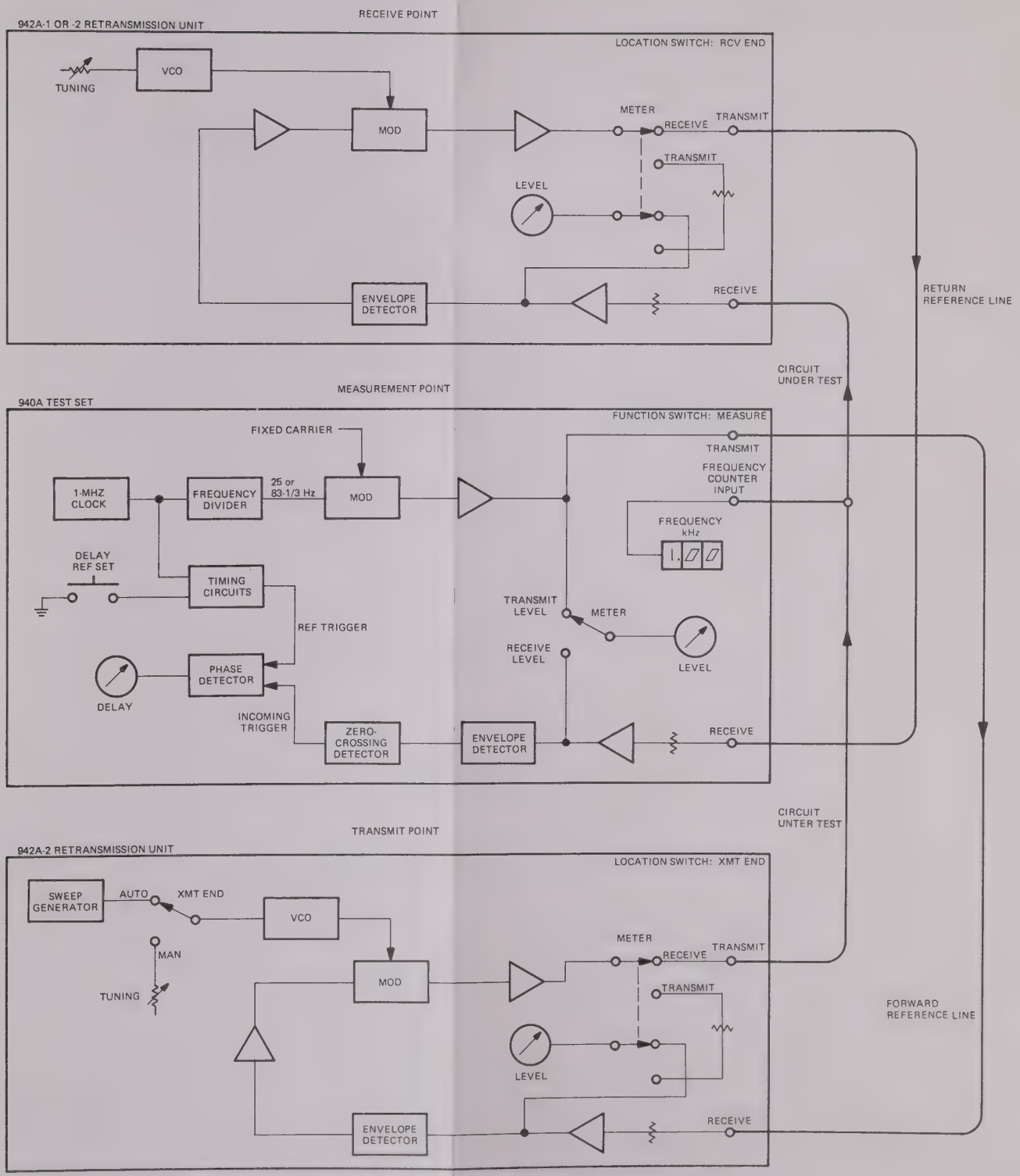


Figure 5-6. Intermediate Point Testing With 942A-2 at Transmit Point

Table 5-6. Intermediate Point Testing With 942A-2 at Transmit Point (Cont)

STEP	PROCEDURE	
	MEASUREMENT POINT	RECEIVE POINT
23		Adjust SWEEP controls on rear panel for required frequency limits and sweep time. See paragraph 5.07.
24	Adjust DELAY RANGE switch for optimum DELAY meter readings over the swept band.	
25	Record level and delay information as required.	

SECTION 6
MAINTENANCE

6.01 This section of the manual pertains to maintenance that can be performed at the operator level. If further information covering service or maintenance of the 942A is needed, contact the Customer Service Department:

ADDRESS: Customer Service Department
Sierra Electronic Operation
Philco-Ford Corporation
3885 Bohannon Drive
Menlo Park, California 94025
(415) 322-7222
TWX 910-373-1282

NOTE: If defective equipment is to be returned to the factory under terms of the Warranty, be sure to contact the Customer Service Department of Sierra Electronic Operation for specific instructions prior to packing and shipping the 942A.

REPLACEABLE PARTS

6.02 Parts that can be replaced easily by the operator are listed in Table 6-1. Replacement of circuit boards or components on the circuit boards will probably necessitate testing or calibration that is beyond the scope of this manual; refer to Operation/Maintenance Manual SMM-942A.

BENCH MODEL KIT INSTALLATION

6.03 A bench model kit is supplied with each test set. If the test set is to be fitted with the bench model kit, proceed as follows (Figure 6-1):

Step 1
Remove adhesive-backed strips (1) from front left and right-hand sides of test set.

Step 2
Place locking device (2) over center hole on right side of test set (square portion will fit into channel on test set).

Step 3
Align hole on arm (3) with hole on locking device and secure with shoulder screw.

Step 4
Repeat steps 2 and 3 for left side arm attachment.

Step 5
Connect 8-inch handle (4) to end of each arm with flat head screws.

Table 6-1. Field Replaceable Parts

DESCRIPTION	SIERRA STOCK NO.	MANUFACTURER	MFR PART NO.
Fuse, 0.5A, 250V	913200036	Littelfuse	312.500 3AG
Power Cord	916400019	Belden	17258

Step 6
Place adhesive-backed cover (5) over outside of each handle arm.

Step 7
Attach four rubber feet (6) in place on bottom of test set.

Step 8
Attach two adhesive-backed strips (7) to each side of test set. These are used in place of original strips when bench model kit is installed.

RACK MOUNTING KIT

6.05 If test set is to be mounted in a standard 19-inch equipment rack, obtain Sierra Rack Mounting Kit Accessory, Part No. A02838501. To install the rack mounting kit, proceed as follows (Figure 6-2).

Step 1
Remove adhesive-backed strips (1) from front left and right-hand sides of test set.

Step 2
Connect right-angle brackets (2) to either side of test set using two screws supplied.

Step 3
Remove the four feet from bottom of test set.

Step 4
Determine on which side of the rack test set is to be mounted, and attach blank panel (3) to opposite side. (Figure 6-2 illustrates a left side mounting configuration.)

Step 5
Connect spacer plate (4) to blank panel (3) using two screws supplied.

Step 6
Attach spacer plate (4) to right-angle bracket (2), using two screws supplied.

Step 7
Test set is now ready to be mounted in a standard 19-inch equipment rack.

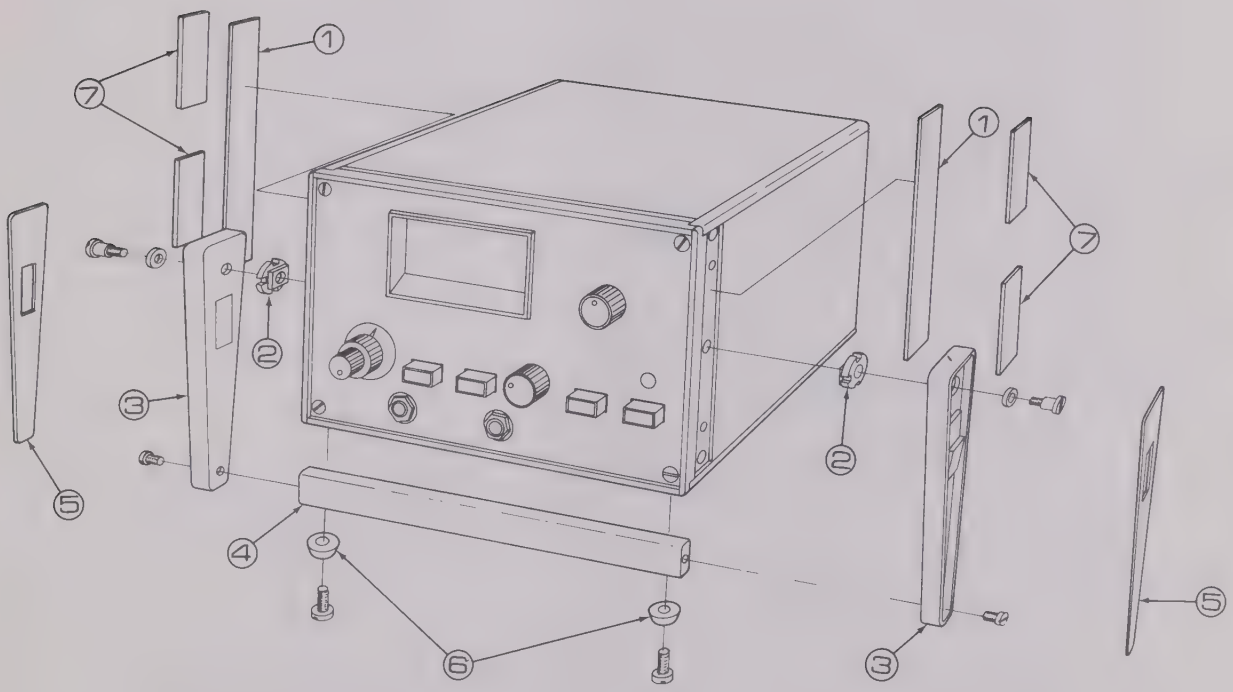


Figure 6-1. Bench Model Kit Installation

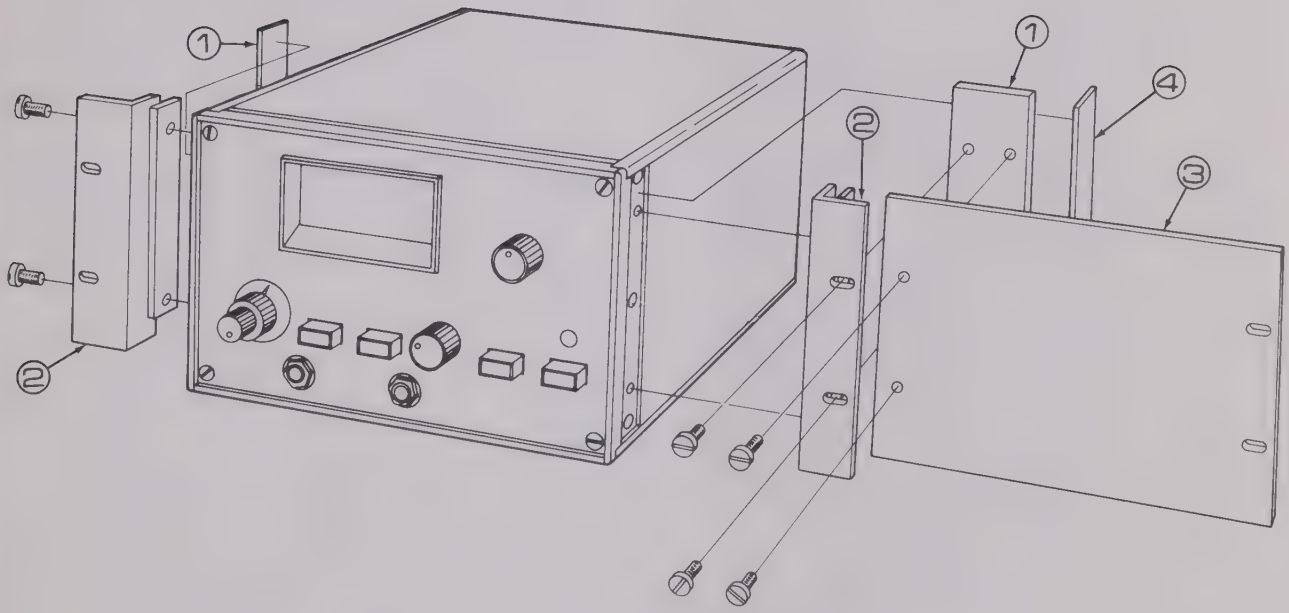


Figure 6-2. Rack Mounting Kit Installation

SIERRA ELECTRONIC OPERATION

Marketing Department

PRODUCT RETURN REPORT

Authorization For Return

(Please Print or Type)

1. Customer _____
   Address _____
   _____
   _____

2. Item Returned. _____
   Model No. _____
   Serial No. _____

3. Return Authorized By _____
   (Sierra Representative)

4. Area Code and Telephone No. and Party to Contact
   for Further Details _____
   _____

5. Reason for Return
   (Please Explain in Full Detail the Indications of Failure)
   _____
   _____
   _____
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   _____

Warranty

SIERRA ELECTRONIC OPERATION, PHILCO-FORD CORPORATION warrants products manufactured by it to be free from defects in material and workmanship and to meet the applicable specifications under normal use and service for a period of 12 months from the date of original shipment by us. Our obligation under this warranty is limited to the repair or replacement of such products which, after having been returned to the factory or a point designated by us, shall be examined and in our sole opinion, found defective and that such defect was not induced by causes external to the product. Alternately, SIERRA may elect to issue credit for any such defective product.

All products to be repaired or replaced shall be returned prepaid to the designated place of repair in accordance with authorization and packing and shipping instructions issued by SIERRA. Return shall not be made until such authorization and instructions are issued. Each returned product shall be accompanied by a statement or report fully stating the claimed defects and any other pertinent information concerning the failure.

SIERRA'S responsibility under this warranty does not apply to any products which have been repaired, worked upon or altered by persons not authorized by us so as to in our sole judgement, injure the stability or reliability of such product, or which have been subject to misuse, negligence or accident, or where applicable, the serial number has been altered, effaced or removed. SIERRA shall not be liable for damages resulting from the use of the purchased product, nor shall SIERRA be responsible for any failure in the performance of other items to which the purchased product is connected or the functioning of an entire system or parts of any system of which the purchased product may be a part.

SIERRA reserves the right to make changes in the design or construction of any of its products at any time without incurring any obligation to make changes whatever on units previously purchased. Accessories, including but not limited to all vacuum tubes, fuses, pilot lamps and batteries used with our products are not covered by this warranty. A test setup charge of $25.00 will apply to any returned instrument or microwave component which, after test, is found to meet the applicable specifications.

This warranty is in lieu of all other warranties, expressed, implied or statutory. No representative or person is authorized to represent nor assume for SIERRA any liability in connection with the sale of products other than set forth herein. IN NO EVENT SHALL SIERRA BE LIABLE FOR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES.

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